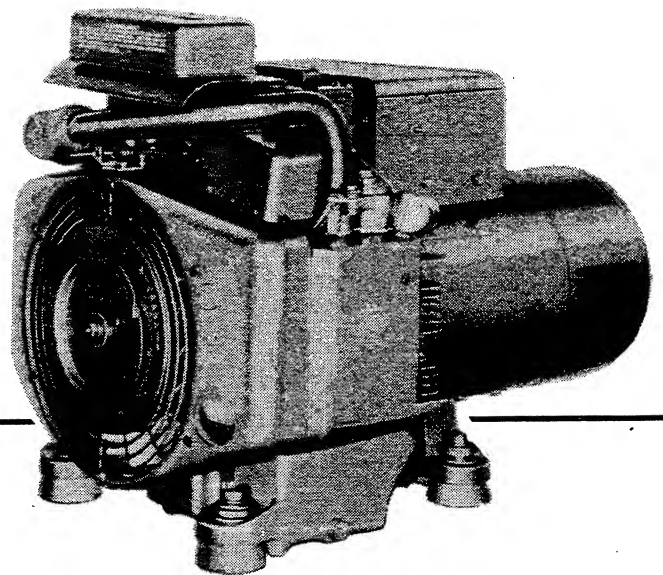




# **Operator's Manual**

## **CCKB**

### **GenSet**



# Safety Precautions

---

Before operating the generator set, read the Operator's Manual and become familiar with it and the equipment. **Safe and efficient operation can be achieved only if the unit is properly operated and maintained.** Many accidents are caused by failure to follow fundamental rules and precautions.

The following symbols, found throughout this manual, alert you to potentially dangerous conditions to the operator, service personnel, or the equipment.

**⚠ DANGER** *This symbol warns of immediate hazards which will result in severe personal injury or death.*

**⚠ WARNING** *This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.*

**⚠ CAUTION** *This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.*

**FUEL AND FUMES ARE FLAMMABLE.** Fire, explosion, and personal injury can result from improper practices.

- DO NOT fill fuel tanks with the engine running unless tanks are outside the engine compartment. Fuel contact with hot engine or exhaust is a potential fire hazard.
- DO NOT SMOKE OR ALLOW AN OPEN FLAME near the generator set or fuel tank. Internal combustion engine fuels are highly flammable.
- Fuel lines must be adequately secured and free of leaks. Fuel connections at the engine should be made with an approved flexible line. Do not use copper piping on flexible lines as copper will work harden and become brittle.
- Be sure that all fuel supplies have a positive shutoff valve.
- DO NOT SMOKE while servicing batteries. Lead acid batteries emit a highly explosive hydrogen gas that can be ignited by electrical arcing or by smoking.

## EXHAUST GASES ARE DEADLY

- Provide an adequate exhaust system to properly expel discharged gases. Inspect the exhaust system daily for leaks per the maintenance schedule. See that exhaust manifolds are secure and are not warped. Do not use exhaust gases to heat a compartment.
- Be sure the unit is well ventilated.

## MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Keep your hands away from moving parts.
- Before performing any maintenance on the generator set, disconnect the starting battery negative (–) ground lead first. This will prevent accidental starting.
- Make sure that fasteners on the generator set are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.

- Do not wear loose clothing or jewelry while servicing any part of the generator set. Loose clothing and jewelry can become caught in moving parts. Jewelry can short out electrical contacts and cause shock or burning.
- If adjustment *must* be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

## ELECTRICAL SHOCK WILL CAUSE SEVERE PERSONAL INJURY OR DEATH

- Remove electric power before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surfaces to be damp when handling electrical equipment.
- Use extreme caution when working on electrical components. High voltages can cause injury or death. DO NOT tamper with interlocks.
- Follow all state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches to avoid accidental closure.
- DO NOT CONNECT THE GENERATOR SET DIRECTLY TO ANY BUILDING ELECTRICAL POWER SYSTEM. Hazardous voltages can flow from the generator set into the utility line. This creates a potential for electrocution or property damage. Connect only through an approved device and after building main switch is open. Consult an electrician in regard to emergency power use.

## GENERAL SAFETY PRECAUTIONS

- Provide appropriate fire extinguishers and install them in convenient locations. Consult your local fire department for the correct type of extinguisher to use. Do not use foam on electrical fires. Use extinguisher rated ABC by NFPA.
- Used engine oils have been identified by some state or federal agencies as causing cancer or reproductive toxicity. When checking or changing engine oil, take care not to ingest, breathe the fumes, or contact used oil.
- Benzene and lead, found in some gasoline, have been identified by some state and federal agencies as causing cancer or reproductive toxicity. When checking, draining or adding gasoline, take care not to ingest, breathe the fumes, or contact gasoline.
- Make sure that rags are not left on or near the engine.
- Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause over heating and engine damage, and present a potential fire hazard.
- Keep the generator set and the surrounding area clean and free from obstructions. Remove any debris from the set and keep the floor clean and dry.
- Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment unsafe.

# GENERAL INFORMATION

## YOUR MANUAL

This manual contains installation, operation, and other information to properly maintain, service, and make adjustments on your CCKB generating set. Study and follow the instructions carefully. A well-planned service and maintenance program will result in longer unit life and better performance. Because the most important part of repair is diagnosis, a troubleshooting guide is included.

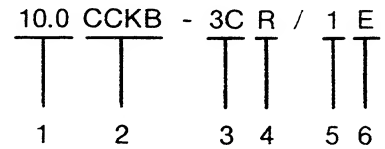
Throughout the manual, engine end of the generating set is the *front*. Left and right sides are determined when *facing* the engine (front) end.

When contacting your Onan dealer, distributor, or the factory about the generating set, always supply the complete model number and serial number as shown on the nameplate (see *Model Designation* following). This information is necessary to identify your generating set among the many types manufactured by Onan.

Where applicable, metric equivalents appear in parentheses following the U.S. customary units.

## MODEL DESIGNATION

The following typical model number is broken down into code segments:



1. Indicates kilowatt rating.
2. Series identification.
3. Voltage code of the generator.  
3 = 120/240 volts  
C = Reconnectible feature
4. Method of starting:  
R - remote electric starting  
P - portable unit with manual starting, and  
E - electric starting.
5. Factory code for designating optional equipment, if any.
6. Specification letter which advances when the factory makes production modifications.

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## WARNING

TO AVOID POSSIBLE PERSONAL INJURY OR EQUIPMENT DAMAGE, A QUALIFIED ELECTRICIAN OR AN AUTHORIZED SERVICE REPRESENTATIVE MUST PERFORM INSTALLATION AND ALL SERVICE.

# SPECIFICATIONS

## ENGINE DETAILS

Number of Cylinders (horizontally opposed) .....	2
Cylinder Bore .....	3.25 inches (82.55 mm)
Piston Stroke .....	3 inches (76.20 mm)
Displacement (cubic inch) .....	49.8 inches (816.22 cm <sup>3</sup> )
Compression Ratio .....	7.0:1
Power Output (3600 r/min) .....	19.5 BHP (14.5 kW)
Engine Speed .....	3600 r/min
Fuel Pump .....	Diaphragm, 4 ft lift (1.2 m)

## IGNITION TYPE

Portable (Manual Start) .....	Flywheel Magneto
Remote Start (Electric Crank) .....	Battery

## STARTING

Portable .....	Manual Pull Rope (Recoil)
Remote Start .....	Exciter Cranking (Gen)
Battery Voltage (Two 6 Volt Batteries in Series) .....	12 V
Capacity Recommendation .....	105 a/hr (378 kC)
Battery Charge Rate (fixed 2-step) .....	1-3 a

## CAPACITIES AND REQUIREMENTS

Oil Capacity .....	4 U.S. quarts (3.8 litre)
Generator Cooling Air (at 3600 r/min) .....	150 CFM (.07 m <sup>3</sup> /sec)
Engine Cooling Air (at 3600 r/min) .....	900 CFM (0.42 m <sup>3</sup> /sec)
Combustion Air (at 3600 r/min) .....	42 CFM (0.02 m <sup>3</sup> /sec)
Total Air Required .....	1092 CFM (0.51 m <sup>3</sup> /sec)

## GENERATOR DETAILS\*

Design .....	2 pole, revolving armature, self-exciter
Power Factor .....	1.0

## TUNE-UP SPECIFICATIONS

Breaker Point Gap (Full Separation) .....	0.020 inch (.51 mm)
Spark Plug Gap	
Gasoline Fuel .....	0.025 inch (.64 mm)
Gaseous Fuel .....	0.018 inch (.46 mm)
Ignition Timing	
Engine Running .....	24° BTC
Static Setting .....	1° ATC (Manual Start), 24° BTC (Electric Start)
Carburetor Float Level (Zenith) .....	1/8 inch (3.18 mm)
Early Models (Carter) .....	11/64 inch (4.37 mm)
Valve Tappet Clearance (Engine Cold)	
Intake .....	0.006 inch - 0.008 inch (0.15 mm - 0.20 mm)
Exhaust .....	0.015 inch - 0.017 inch (0.38 mm - 0.43 mm)
Compression (at cranking speed) .....	100 - 120 PSI (48 - 52 kPa)
Cylinder Head Torque .....	29 - 31 ft lb (39 - 42 N•m)

\* - See nameplate for generator current ratings.

# DESCRIPTION

## GENERAL

An Onan CCKB Series electric generating set consists of a two-cylinder gasoline engine and an alternating current generator with standard or optional equipment as ordered.

## ENGINE

The CCKB engine has 49.8 cubic inch (816 cm<sup>3</sup>) piston displacement, 7.0 to 1 compression ratio, and is air-cooled. Basic measurements and other details are listed under *SPECIFICATIONS*.

## GENERATOR

The generator is a revolving armature, 2-pole, single phase, self-excited model of drip-proof construction.

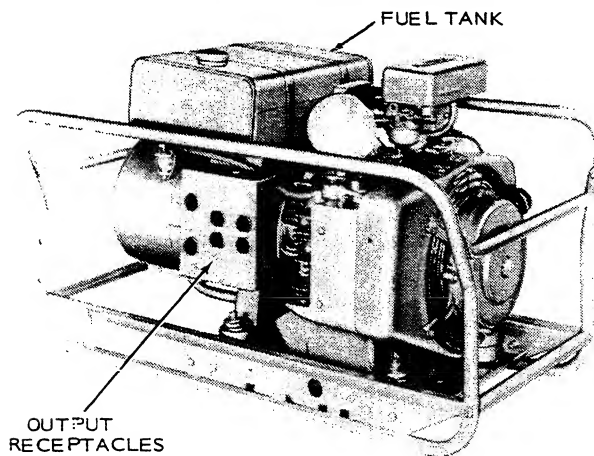
The generator aligns to the engine through a rigid coupling. A commutator, collector rings and associated brushes provide the electrical connections.

## CONTROLS

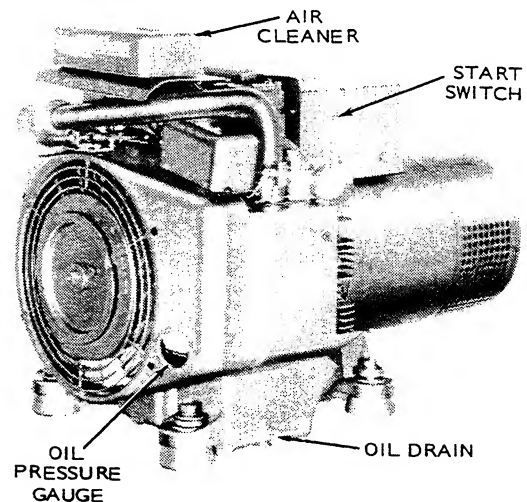
The control box has a START-STOP switch. The portable model has a six receptacle outlet box with a pilot light. The following is a brief description of typical controls.

**Start-Stop Switch:** Starts and stops the unit locally.

**Oil Pressure Gauge:** Indicates pressure of lubricating oil in engine (located on the engine).



PORTABLE



REMOTE START

## TYPICAL CCKB MODELS

# INSTALLATION

## GENERAL

Installations must be considered individually, however, the following installation guidelines should be followed. Installations must conform to local building codes, fire ordinances and other local, state or federal regulations. See Figure 1.

Installation points to consider include:

- 1 Level mounting surface.
- 2 Adequate cooling air.
- 3 Adequate fresh induction air.
- 4 Discharge of circulated air.
- 5 Discharge of exhaust gases.
- 6 Electrical connections.
- 7 Fuel connections.
- 8 Accessibility for operation and servicing.
- 9 Vibration isolation.
- 10 Noise levels.

Provide a location that is protected from the weather and is dry, clean, dust free and well ventilated. If practical, install inside a heated building for protection from extremes in weather conditions.

The air discharge side of set requires 3 inches (76 mm) clearance from wall to permit set to rock on its mounts; at least 24 inches (610 mm) clearance is required around all other sides for service accessibility.

Permanent installations need a sturdy, level mounting base of concrete, heavy wood, structural steel or other sturdy support at least 12 inches (305 mm) high to aid routine maintenance, operation and service.

Assemble the vibration isolators in the order as shown in Figure 2. The spacer bushing prevents compression of the snubber or upper rubber cushion. Two

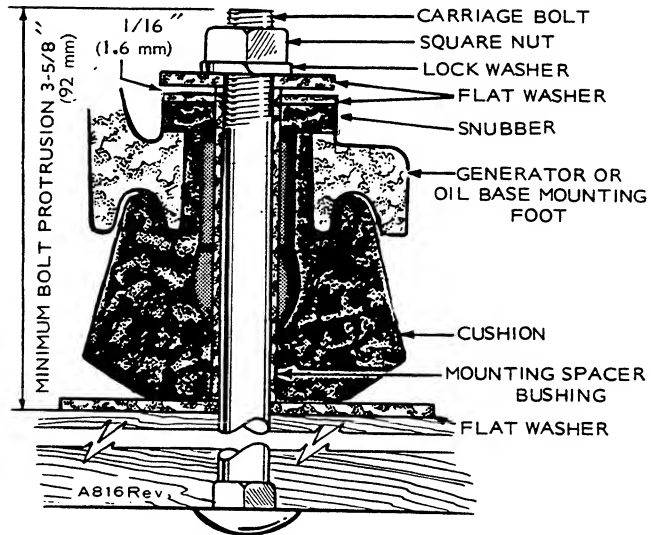


FIGURE 2. VIBRATION ISOLATOR

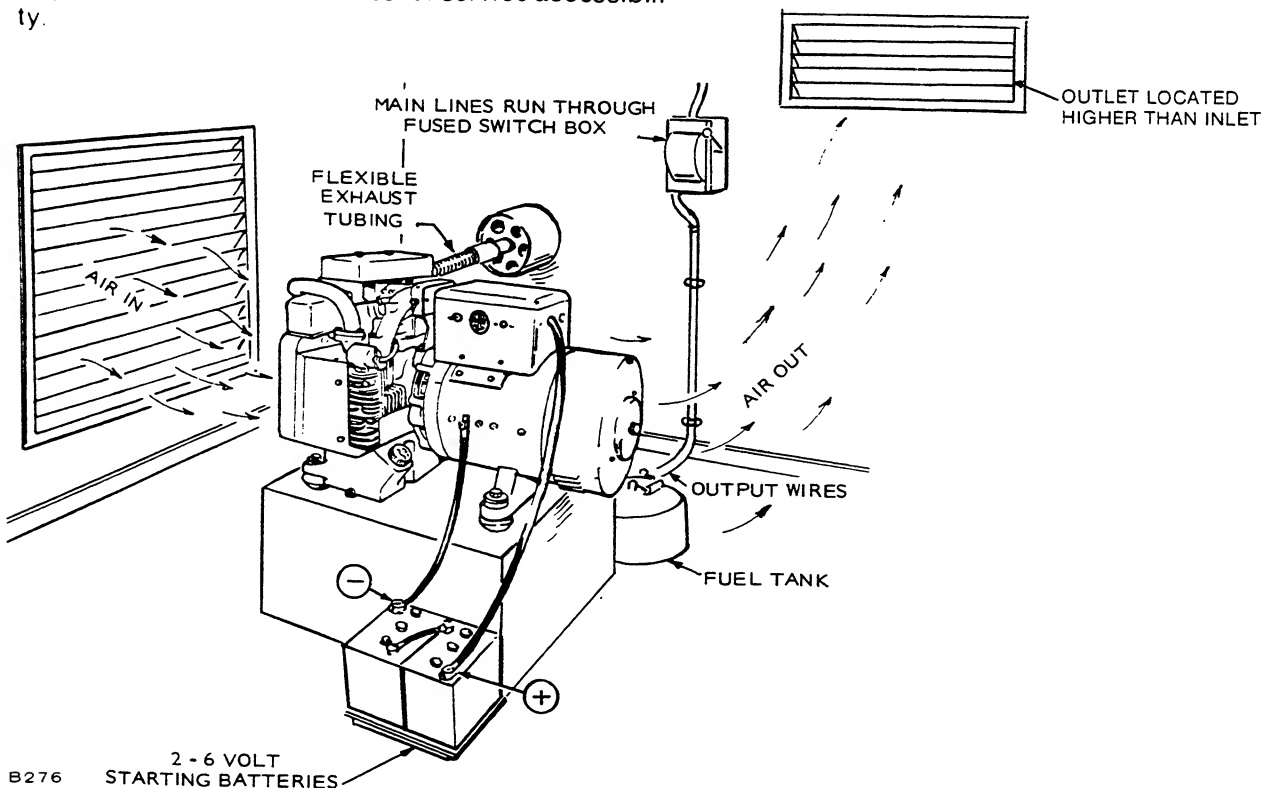


FIGURE 1. TYPICAL CCKB GENERATING SET INSTALLATION

vibration isolators are for the engine end only and the other two are for the generator end only. Use them for their respective positions or undesirable cushioning will result.

## BATTERY CONNECTION

Provide two 6 volt batteries connected in series (Figure 1) for a 12 volt source. See *Specifications* for minimum battery ampere-hour rating.

Connect the battery positive (+) cable to the start solenoid (located in the control box). Route the battery cable through the rear of the control box. Connect the battery negative (-) to a good ground on the generator set frame. See Figures 1 and 3.

**CAUTION** Do not disconnect starting batteries while set is running. The resulting overvoltage condition will damage electric choke and may damage control components.

**Standby Installations:** If the installation is for standby service, install a double-throw transfer switch (either manual or automatic) to prevent feeding generator output into the normal power source lines and to also prevent commercial power and generator output from being connected to the load at the same time.

## GROUNDING

**WARNING** To prevent shock hazard, ground the set. Connect a #8 or larger wire between: (1) a separate ground pipe or rod penetrating into moist earth; (2) and the solderless connector located on the generator (on models not so equipped, to the battery ground stud on the engine). See Figure 3.

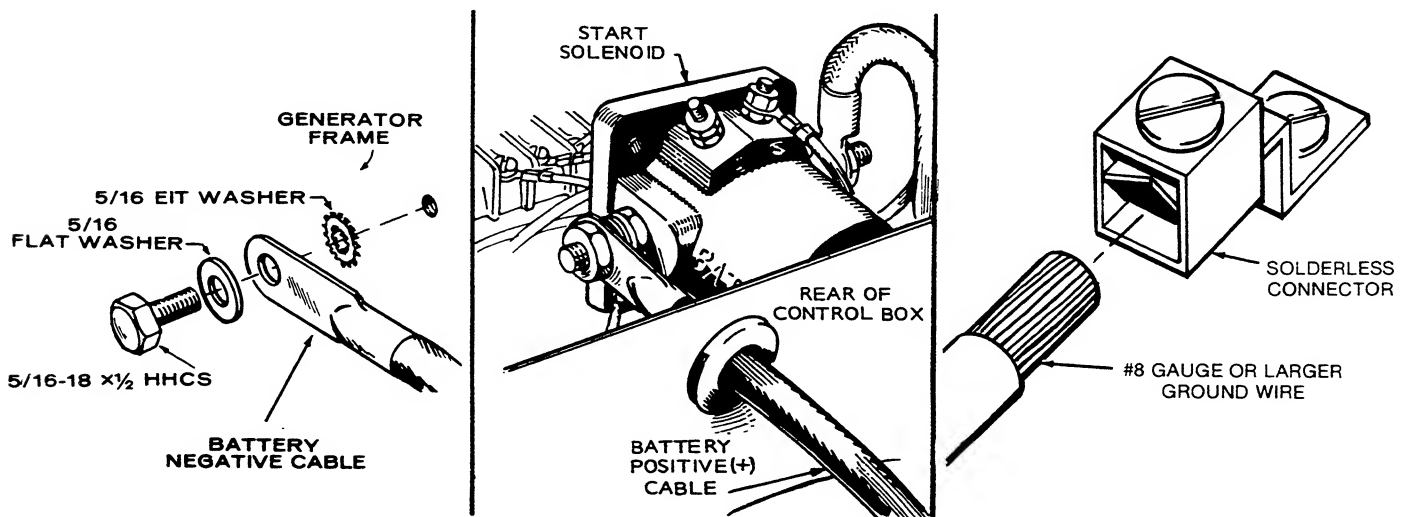


FIGURE 3. BATTERY AND GROUND CONNECTIONS

## VENTILATION AND COOLING

Ventilation and cooling for outdoor installations usually present no problems. Indoor installations, however, require properly sized and located vents for both inlet and outlet air. See *Specifications* section for required airflow. The outlet should be slightly higher than the inlet for convection airflow.

The required amount of air must reach the unit, absorb the heat and be discharged away from the installation area. When determining vent sizes, consider the following:

1. Size of enclosure.
2. Ambient temperature.
3. Electrical load.
4. Running time.
5. Restrictions — screens, filters, etc.
6. Prevailing wind direction.

If the generating set is enclosed in a small, poorly ventilated enclosure, auxiliary fans can be used to increase airflow. The air inlet to the engine must not exceed 120° F (49° C) when running at full load. If inlet air is more than 10° F (12° C) above ambient air, there is a good possibility that cooling air is recirculating.

**Pressure Cooling:** These units need an inlet vent with an unrestricted opening of 2-1/2 square feet (2.3 m<sup>2</sup>). Install a separate duct from the engine for the discharge air.

The discharge duct must be at least as large as the inlet vent. If a screen is used in the duct, increase the duct size proportionately to the screen restriction. Use large radius elbows for bends and increase the duct size for runs over 5 feet (1.5 m). A canvas section in the duct prevents transmission of vibration. A slight pitch upward in the duct lets heat escape when the unit is stopped and minimizes vapor lock.

**WARNING** Do not use discharged air for heating since it may contain poisonous gases.

## FUEL

**Fuel Connection (Gasoline):** For gasoline-fueled generating sets, other than the contractor and portable models which have their own fuel tank, connect a fuel line to the fuel pump inlet, which is threaded 1/8-inch NPTF (National Pipe Thread Female). Use a flexible line next to the unit to prevent transmission of vibration to the fuel line.

**Fuel Connection (Gaseous):** For gaseous-fueled generating sets, check with your local supplier for gas and pressure regulations. See Figure 4. Provide a manual gas shutoff. A filter in the line may also be necessary. Electric solenoid shutoff valves are usually required for indoor automatic or remote starting installations. Connect the solenoid wires to the battery circuit to open the valve while the unit is running. Also install a demand-type regulator and locate it near the generating set to aid starting (regular line pressure must be within 2 to 8 ounces [57 to 227 g]).

**Always use flexible tubing between engine and gas demand regulator to absorb vibration.**

**Gasoline Tank:** If a separate fuel tank is used, install the tank so its bottom is less than 4 feet (1.2 m) below the fuel pump. The tank top must also be below the fuel pump level to prevent siphoning. If the fuel tank is shared with another engine, use a separate fuel line.

If the fuel must be listed over four feet (1.2 m), install an auxiliary electric fuel pump at the fuel supply.

An auxiliary reservoir fuel tank is often used for standby installations. For these installations, the fuel line connections must be changed as shown in Figure 5.

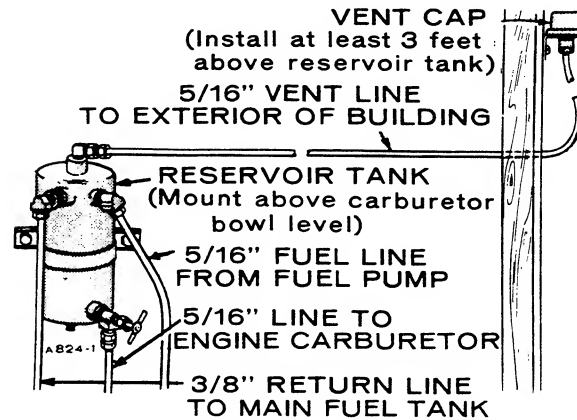


FIGURE 5. AUXILIARY RESERVOIR FUEL TANK

### WARNING

In most vehicle applications since August, 1972, the vehicle uses an Evaporative Emission Control System. These systems may become pressurized if the normal venting system becomes plugged. If this occurs when the generating set is not running and especially if vehicle is moving, gasoline can be forced through the carburetor, flooding the generator set. For this reason a separate manual or electrical fuel shut-off **MUST** be provided in the fuel line between the supply tank and the generator set fuel pump inlet to prevent flooding the generator set when not in use.

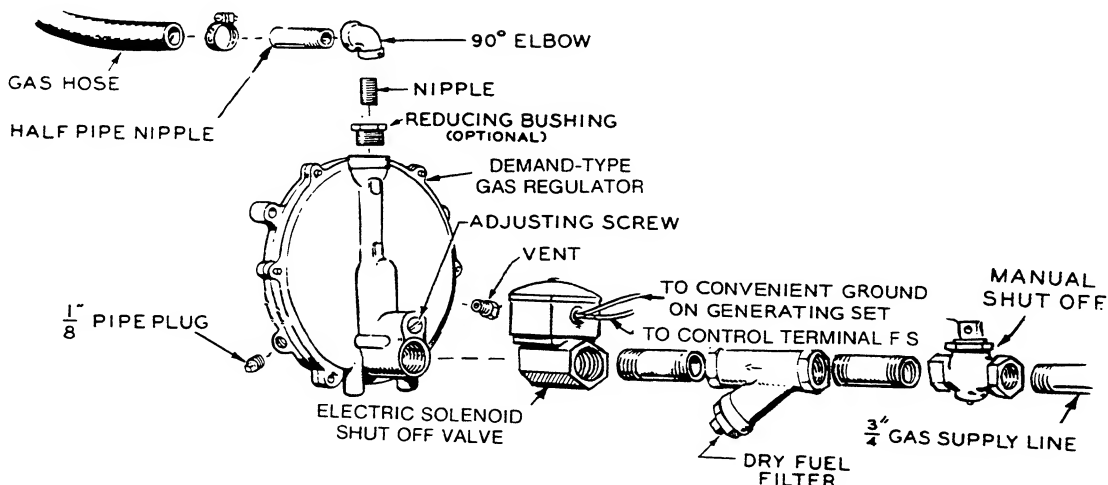


FIGURE 4. CONNECTIONS FOR GAS LINE TO CCKB



## EXHAUST

Vent all exhaust gases outside. The exhaust outlet must not terminate near air inlet vents or combustible materials. Avoid sharp bends and use large radius elbows in the exhaust piping. If the piping cannot be pitched downward, install a condensation trap in the system where a rise begins (Figure 6). The exhaust line connects to a one-inch NPTF outlet at engine. Use one pipe size larger for each ten feet in length. Position the exhaust outlet away from the set air intake.

**WARNING** Pipe POISONOUS exhaust gas outside enclosure. Inhalation of exhaust gases can result in serious injury or death.

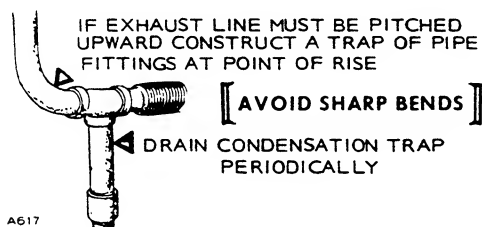


FIGURE 6. CONDENSATION TRAP

Exhaust piping must not come closer than 9 inches to combustible material. Where the system leaves the building, install a thimble. See Figure 7.

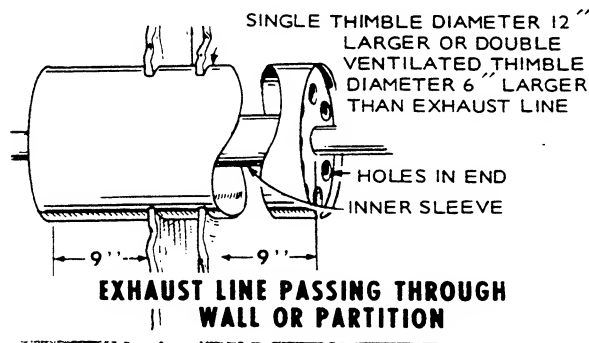


FIGURE 7. EXHAUST THIMBLE

## OIL DRAIN

If desired for convenience in draining oil, remove the oil drain plug and install an extension pipe and coupling. Oil base has 3/8-inch pipe tapped hole.

## REMOTE START-STOP SWITCH (Optional)

For remote control starting and stopping, use three wires to connect the remote switch (SPDT, momentary contact, center-off type) to the terminal block marked B+, 1, 2, 3, in the set control box. Use #18 gauge wire for runs up to 250 feet (76 m) and larger wire for longer runs. See Figure 8.

## LOAD WIRE CONNECTIONS

The generating set nameplate shows the electrical output rating of the set in watts, volts and hertz. The portable models are prewired and have a receptacle box with two duplex 120-volt (15-ampere), grounding receptacles and two 240-volt (20-ampere), twist-lock receptacles. For the other generating sets, the wiring diagram shows the electrical circuits and necessary connections for the available output voltage.

A qualified serviceman or electrician should make the installation and the installation should be inspected and approved to meet all applicable code requirements. The AC output box has provisions to accommodate load wires. Use flexible conduit and sufficiently large stranded load wires near the set to absorb vibration. Strip the insulation from the wire ends as necessary for clean connections. Connect each load wire to the proper generator output lead inside the AC output box. Insulate bare ends of ungrounded wires. Install a fused main switch (or circuit breaker) between the generating set and the load.

**Reconnectable, Single-Phase Generator:** Voltage selection on reconnectable single-phase generators is 120/240 volts, 3 wire; 120 volts, 2 wire; or, 240 volts, 2 wire (Figure 9). Use the connection for two-wire service when one load exceeds one-half the rated capacity. Balance the load when connecting for three-wire service. Current for any one output lead must not exceed nameplate rating. Serious overloading can damage the generator windings. When two or more single-phase circuits are available, divide the load equally between them.

**Three-Phase, Four-Wire, Wye Connected Generators:** A three-phase, four-wire generating set produces single-phase current of the lower nameplate voltage and three-phase current of the higher nameplate voltage (Figure 10). For single-phase current, connect the neutral (white) load wire to the grounded M<sup>0</sup> terminal. Connect the "hot" (black) load wire to any one of the other three terminals . . . M<sup>1</sup>, M<sup>2</sup> or M<sup>3</sup>. Three separate single-phase circuits are available, with not more than one-third the rated capacity of the generating set from any one circuit. For three-phase current, connect separate load wires to each of the generator terminals M<sup>1</sup>, M<sup>2</sup> and M<sup>3</sup>. Single-phase current of the higher nameplate voltage is obtained between any two three-phase terminals.

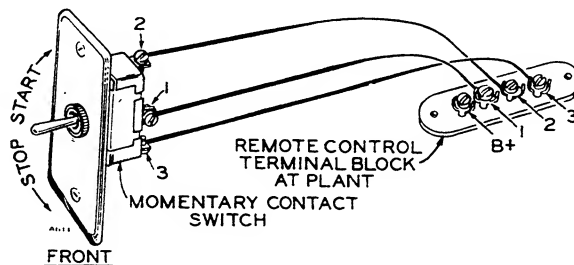


FIGURE 8. REMOTE START-STOP SWITCH

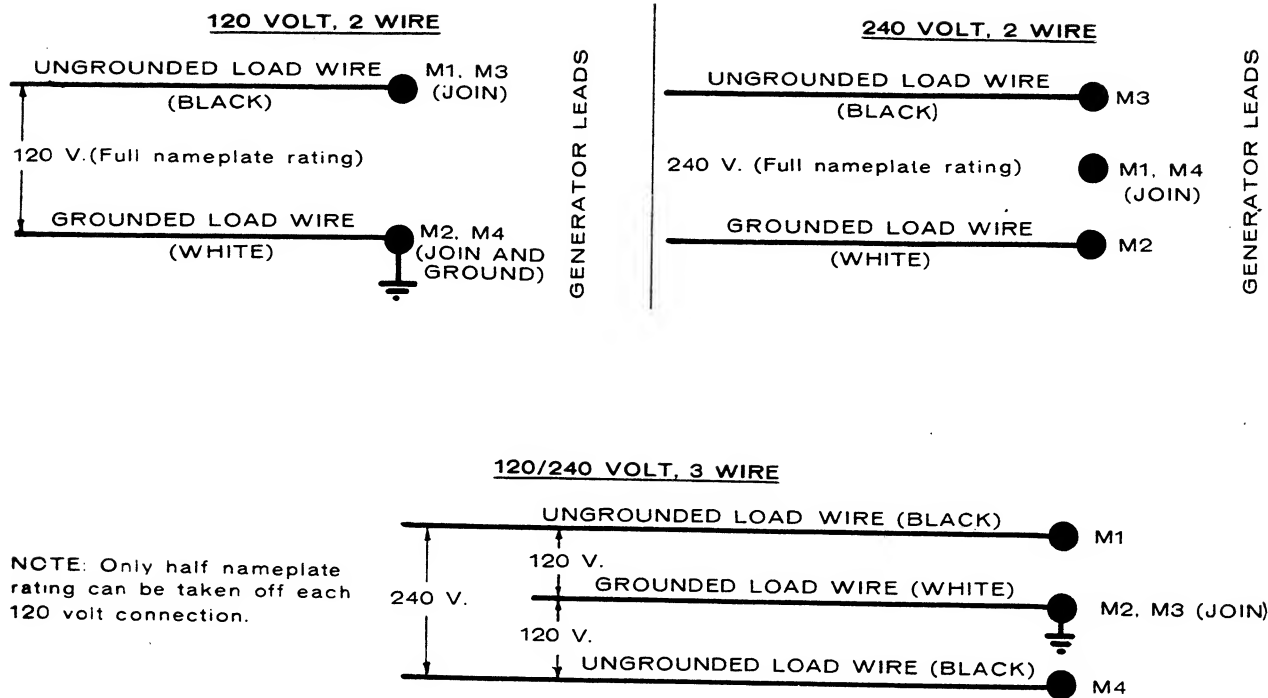


FIGURE 9. SINGLE PHASE, 3CR GENERATOR CONNECTIONS

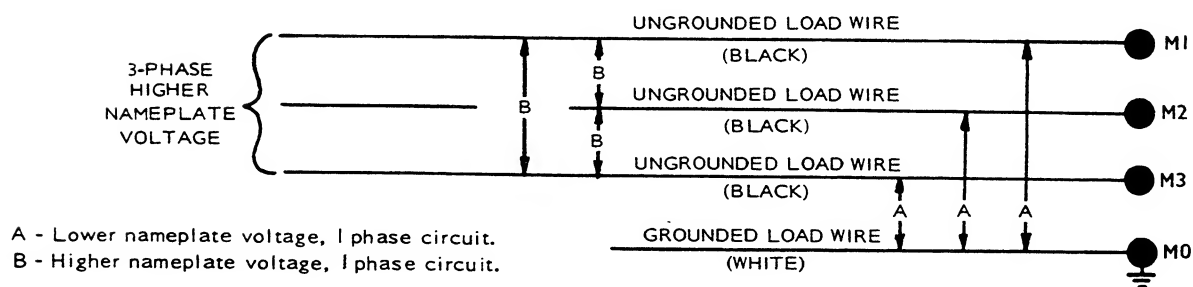


FIGURE 10. THREE PHASE WYE GENERATOR CONNECTIONS FOR VOLTAGE CODES -4 AND -4X.

# OPERATION

## INITIAL START

Check the engine to make sure it has been filled with oil and fuel. If engine fails to start at first attempt, inhibitor oil used at the factory may have fouled the spark plugs — remove, clean in a suitable solvent, dry thoroughly and install. Heavy exhaust smoke when the engine is first started is normal and is caused by the inhibitor oil.

**Crankcase Oil:** Use a good quality, heavy duty oil with the API (American Petroleum Institute) designation SE or SE/CC (gasoline operation only). If this oil is not available, SD or SD/CC designated oil can be used. For gaseous fuel operation, use an ashless or low-ash detergent oil specifically made for gaseous fueled engines.

Oil consumption may be higher with a multigrade oil than with a single-grade oil if both oils have comparable viscosities at 210° F (99° C). Therefore, single grade oils are generally more desirable unless anticipating a wide range of temperatures. Use the proper grade oil for the expected conditions (Chart 1).

**CHART 1. OIL RECOMMENDATIONS ACCORDING TO  
AIR TEMPERATURE**

Above 32° F (0° C) .....	SAE 30
0° F to 32° F (0° C) .....	SAE 10W-40 or 5W-30
Below 0° F (-18° C) .....	SAE 5W-30

Do not mix brands or grades. Refer to *Maintenance* section for recommended oil changes.

**Recommended Fuel:** For new engines, most satisfactory results are obtained by using nonleaded gasoline. For older engines that have previously used leaded gasoline, heads must be taken off and all lead deposits removed from engine before switching to nonleaded gasoline. Do not use highly leaded premium fuels.

**WARNING** Never fill the tank when the engine is running and leave some fuel expansion space to prevent possibility of explosion.

**CAUTION** If lead deposits are not removed from engine before switching from leaded to nonleaded gasoline, pre-ignition could occur causing severe damage to the engine.

## ELECTRIC STARTING

**Remote Control, AC Set:** Push the *start-stop* switch to its *start* position. Release the switch as soon as the set starts.

## MANUAL STARTING

**Portable Type Set:** Close the manual choke about three-quarters or as necessary according to temperature conditions. Pull the start rope with a fast, steady pull to crank the engine. Do not jerk. As the set warms up, adjust the choke gradually to its fully open position.

## APPLYING LOAD

Allow set to warm up before connecting a heavy load and keep the load within nameplate rating. Continuous generator overloading may cause high operating temperatures that can damage the windings.

## BATTERY CHARGING

The battery charge rate is controlled by a two-step charge regulator. This regulator is preset and is not adjustable.

## SAFETY DEVICES (Optional)

A *high air temperature switch* can be installed in the cooling system that stops the set if the engine overheats.

If the engine has a low oil pressure switch, the switch will stop the set whenever the oil pressure drops below a safe operating pressure. After such a stop, investigate and correct the cause.

## BREAK-IN PROCEDURE

A reconditioned unit should be run in the following sequence using SE or SE/CC oil (see oil requirements for correct viscosity). New units have been run under load at the factory.

1. One half hour at half load.
2. One half hour at three quarter load.
3. Full load for several hours, if possible.

This method of load application speeds piston ring seating. Continuous running at half (or lighter) load for the first few hundred hours usually results in poor piston ring seating, causing higher than normal oil consumption and blow-by.

## STARTING SEQUENCE

1. Operator pushes START switch or set is started by remote control.
2. Start solenoid energizes.
3. Battery current flow to:
  - a) series field
  - b) STOP relay
  - c) electric choke
4. Ignition coil fires spark plugs when breaker points open.
5. Engine starts
6. Operator releases START switch
7. Start-disconnect relay energizes
8. Engine continues running.

## STOPPING SEQUENCE

1. Operator pushes STOP switch
2. Stop relay opens ignition circuit
3. Engine stops
4. Operator releases STOP switch.

## GENERATING SET EXERCISE

Infrequent use results in hard starting. Operate generating set one 30-minute period each week. Run longer if battery needs charging, or keep battery charged with a separate charger. Exercising for one long period each week is better than several short periods.

## GAS-GASOLINE CONVERSION

Engines having a combination gas-gasoline carburetor can be switched to gasoline operation by the following procedure:

1. Close the gaseous fuel shutoff valve in supply line, wherever located.
2. Open the gasoline fuel shutoff valve, wherever located.
3. Set the spark plug gap as given in the *Specifications* section.
4. See that the choke is free and works easily (be sure to release choke lock on units with electric choke).
5. Start the engine. If the engine runs unevenly under half or full load, the carburetor main jet probably needs adjusting. This is not the same main adjusting screw as that used for gaseous fuel. Another adjusting screw is provided for this purpose (refer to *Adjustments* section).

To change back to gaseous fuel operation, reverse the above procedure.

## HIGH TEMPERATURE OPERATION TIPS

1. See that nothing obstructs air flow to-and-from the set.
2. Keep cooling system clean.
3. Keep ignition timing properly adjusted.
4. Use correct oil grade (heavier).

## LOW TEMPERATURE OPERATION TIPS

1. Use correct SAE No. oil for temperature conditions. Change oil only when engine is warm. If an unexpected temperature drop causes an emergency, move the set to a warm location or apply heated air (never use open flame) externally until oil flows freely.
2. Use fresh non leaded or regular grade (not *premium*) gasoline. Protect against moisture condensation. Below 0° F (-18° C) adjust carburetor main jet for slightly richer fuel mixture.
3. Keep ignition system clean, properly adjusted, and batteries in a well charged condition.
4. Partially restrict cool air flow but use care to avoid overheating.

## HIGH ALTITUDE

For operation at altitudes of 2500 feet (762 m) above sea level, close carburetor main jet adjustment slightly to maintain proper air-to-fuel ratio (refer to *Adjustments* section). Maximum power will be reduced approximately 4 percent for each 1000 feet (305 m) above sea level, after the first 1000 feet (305 m).

## DUST AND DIRT

1. Keep set clean. Keep cooling system clean.
2. Service air cleaner as frequently as necessary.
3. Change crankcase oil every 100 operating hours.
4. Keep oil and gasoline in dust-tight containers.
5. Keep governor linkage clean.
6. Clean generator brushes, slip rings and commutator — do not remove normal (dark brown) film. Do not polish.

## EXTENDED OUT-OF-SERVICE PROTECTION

Generator sets removed from service for extended periods of time (over 30 days) should be protected from rust and corrosion. Onan recommends the following protective procedure:

1. Run set until thoroughly warm with generator under at least 50 percent load. Stop engine by shutting off fuel supply to allow engine to drain fuel lines and carburetor.
2. Drain oil base while still warm. Refill and attach a tag indicating viscosity of oil used.
3. Remove spark plugs. Pour 1-ounce of rust inhibiting oil (or SAE #10 oil) into each cylinder. Crank engine over several times. Install spark plugs.
4. Service air cleaner.
5. Clean throttle and governor linkage; protect by wrapping with a clean cloth.
6. Plug exhaust outlets to prevent entrance of moisture, bugs, dirt, etc.
7. Clean off dirt and dry entire unit. Coat parts likely to rust with a light film of oil or grease.
8. Disconnect battery and follow standard battery storage procedure. Apply a film of non-conductive grease (e.g., vaseline) to battery cable terminal lugs.
9. Fill fuel tank to prevent condensate contamination.
10. Provide a suitable protective cover for the entire unit.

## RETURNING UNIT TO SERVICE

1. Remove cover and all protective wrapping. Remove plug from exhaust outlet.
2. Check tag on oil base and verify that oil viscosity is still correct for existing ambient temperature.
3. Clean and check battery. Measure specific gravity (1.260 at 25° C [77° F] ) and verify level to be at split ring. If specific gravity is low, charge until correct value is obtained. If level is low, add distilled water and charge until specific gravity is correct. DO NOT OVERCHARGE.

### WARNING

Do not smoke while servicing batteries. Explosive gases are emitted from batteries in operation. Ignition of these gases can cause severe personal injury.

4. Connect batteries.
5. Verify that no loads are connected to the generator.
6. Start engine.

After engine has started, excessive blue smoke will be exhausted and the engine will run rough until the rust inhibitor or oil has burned away.

7. After start, apply load to at least 50 percent of rated capacity.
8. Check all gauges for correct reading. Unit is ready for service.

# ADJUSTMENTS

## BREAKER POINTS - TIMING

For best engine performance, it is essential that the breaker point gap and the ignition timing are correctly set. Timing should always be checked when the breaker points are adjusted or replaced. Always replace breaker points that are burned or pitted.

### Breaker Points

To check the breaker point gap, remove the breaker box cover and crank the engine slowly by hand in the direction of crankshaft rotation (clockwise as viewed from engine front) until the points just start to open. Continue turning until the points are fully separated (about 1/4 turn). Using a clean, flat thickness gauge, check for a proper separation of .020 inch (0.51 mm). To adjust the gap (Figure 11), loosen locking screws (A) and turn the off-center screw (B) until separation is correct. Retighten the locking screws (A) and recheck gap.

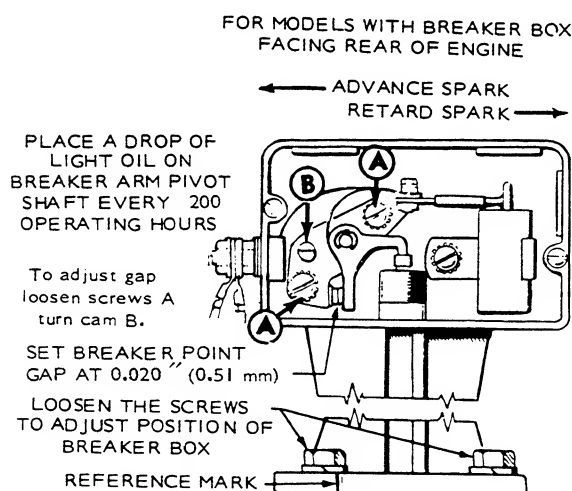


FIGURE 11. BREAKER POINTS

### Timing

The ignition timing marks can normally be viewed through the blower housing on the front of the engine. Align the timing mark stamped on the flywheel with the marks stamped on the gear cover (Figure 12). If more than one mark is stamped on the flywheel, align the TC mark on the flywheel with the gear cover marks. Engines equipped with Vacu-flo cooling have a removable dot button on the blower housing for viewing timing marks (Figure 13).

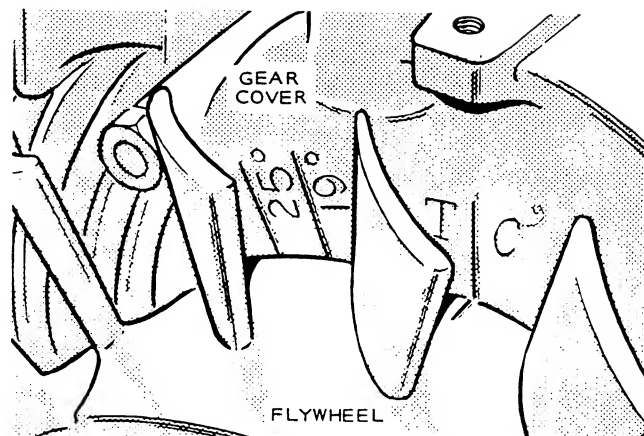


FIGURE 12. TIMING MARKS

To check the ignition timing with the engine not running, connect a continuity tester across the breaker points. Turn the engine against crankshaft rotation (counterclockwise as viewed from engine front) until the points close (tester shows continuity). Then slowly turn the engine with rotation until continuity just ceases (points are just opening). At this setting, the timing pointer should align with the correct timing mark.

To check the ignition timing with the engine running, connect an automotive timing light to either spark plug and start the engine. With the engine running at rated speed, the timing mark on the flywheel should align with the correct timing mark on the gear cover.

To change the timing setting, loosen the two breaker box mounting screws and slide the breaker box assembly to advance or retard the ignition spark (Figure 11).

## CARBURETOR ADJUSTMENTS

Before attempting carburetor adjustments, make sure the ignition system, choke, and governor are all functioning properly. If the carburetor is completely out of adjustment so the engine will not start, a reasonably close preliminary setting can be obtained by turning the adjustment screws in until lightly seated and then turning them out 1 to 1-1/2 turns (3 turns for gaseous fueled carburetors operating on 800 BTU fuel). Do not force the screws tight against their seats or damage may occur.

If operating on gas fuel with the gas-gasoline carburetors, be sure to lock the electric choke open (where used).

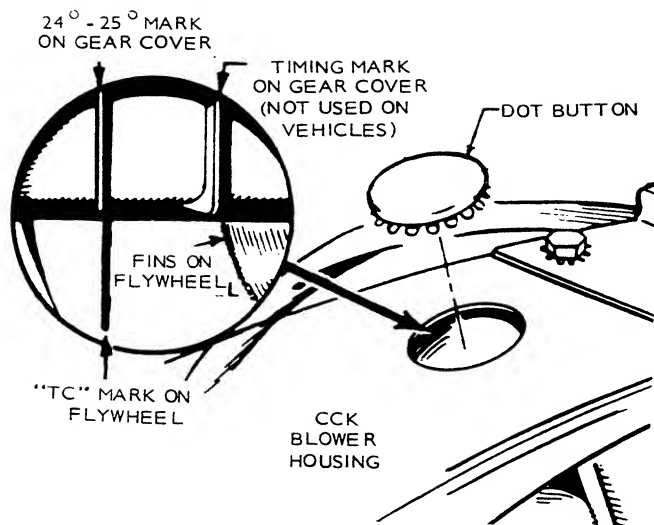


FIGURE 13. VACU-FLO TIMING MARKS

### Mixture Screws Adjustment

The same adjustment procedures are used whether the carburetor is operating on gasoline or gaseous fuel. Carburetors running on gaseous fuel are factory set for gas rated at approximately 1000 BTU. If the fuel rating to be used is substantially different, a readjustment of the fuel mixture is required. To set the adjustment screws, proceed as follows:

1. Start the engine and allow it to warm up (on gasoline fueled engines, allow to warm until choke is fully open).
2. Apply a full load to the engine.

3. Turn in the main fuel adjustment screw (Figure 14) until engine speed drops. Then turn out screw until engine speed returns to normal.
3. Remove load from the engine.
4. Turn the idle adjustment screw out until engine speed drops slightly. Then turn the screw in until speed returns to normal.

Carburetors equipped for gaseous fuel operation only are identical to the carburetor shown in Figure 14, except the parts not necessary for gaseous fuel operation (the choke, gasoline adjustment screws, and the float assembly) have been removed.

**CAUTION** Loosen packing nut before turning gasoline main adjustment and tighten to a snug fit after adjustment has been made. Hold the adjustment while tightening packing nut. This procedure will prevent air entry that causes rough engine operation and fuel leaks. The fuel leaks occur when the engine is not running and cause difficult starting because the float level is lowered.

### Alternate Method (No Load Adjustment)

1. Start the engine and allow it to warm up.
2. Push in on the governor mechanism to slow the unit down to about 400 to 500 rpm.
3. Release the governor mechanism to allow the engine to accelerate. If the engine accelerates evenly and without a lag, the main adjustment screw setting is correct. If not, adjust the screw outward about 1/2 turn and again slow down the engine and release the mechanism. Continue until the engine accelerates evenly and without a time lag after releasing the governor.
4. Push in on the governor mechanism to slow the unit to 400 to 500 rpm. Set the idle adjustment screw so the engine is firing on both cylinders and running smoothly.

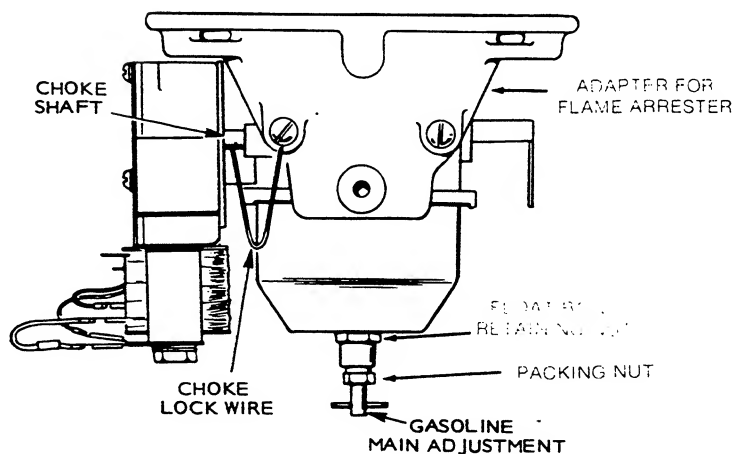
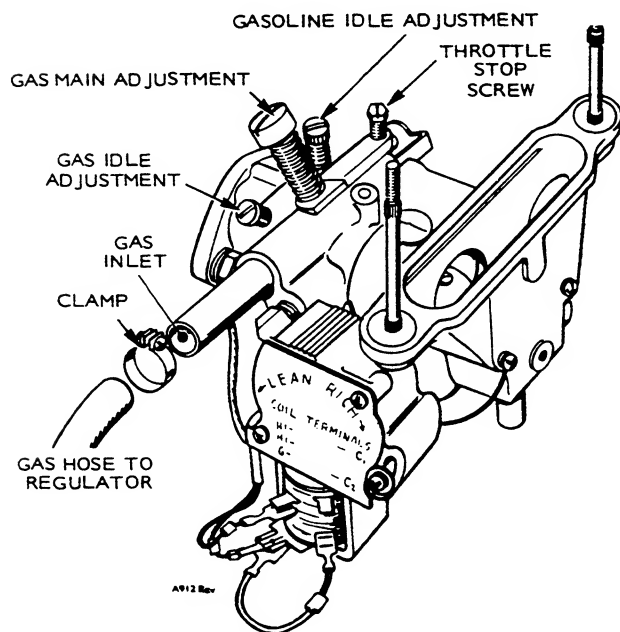


FIGURE 14. GAS-FUELED CARBURETOR ADJUSTMENTS

## Float Level Adjustment

To check float level, remove the entire main fuel adjustment assembly from the float bowl (unscrew large nut from float bowl, Figure 14). For correct carburetor float clearance see Figure 15. Adjustment is made by bending the tab on the float. The float tab should just touch fuel inlet valve and not compress the inlet valve spring.

Do not apply excessive pressure to float valve.

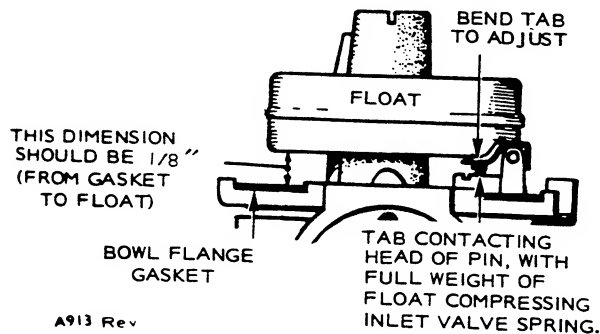


FIGURE 15. SETTING FLOAT LEVEL

## Throttle Stop Screw Adjustment

Set throttle stop screw (located on carburetor throttle lever) with no load connected and while running at rated speed. Turn the screw to give 1/32-inch (0.79 mm) clearance between the screw and pin (Figure 17).

## ONAN THERMO-MAGNETIC CHOKE

This choke uses a heating element and a heat-sensitive bi-metal spring to open the choke plate. The choke solenoid, actuated during engine cranking only, closes the choke plate according to ambient temperature.

If the engine has been running, allow it to cool at least one hour before attempting choke adjustment. Adjust the choke as follows:

1. Remove the flame arrester and adapter (Figure 14) to expose the carburetor throat.
2. Loosen the screw that secures the choke body (Figure 16).
3. Rotate the choke body until the proper setting is achieved. Refer to Figure 16 for correct choke settings at various ambient temperatures. Use drill rod or the shank of a drill bit to measure the choke opening.

## GOVERNOR

The governor and vacuum booster control engine speed. Rated speed and voltage appear on the nameplate (see *Specifications*). On a 2 pole generator, engine speed equals frequency multiplied by 60—thus 3,600 rpm gives 60-cycle frequency. Preferred speed does not vary more than 3 cycles from no-load to full-load operation. Be sure throttle, linkage, and governor mechanism operate smoothly. Refer to Figure 17 and make adjustments as follows:

**Linkage:** The engine starts at wide open throttle. The length of the linkage connecting the governor arm to the throttle arm is adjusted by rotating the ball joint. Adjust length so that with the engine stopped and with tension on the governor spring, the stop screw on the carburetor throttle lever is 1/32-inch (0.79 mm) from the stop pin. This setting allows immediate control by the governor after starting, and synchronizes travel of the governor arm and the throttle shaft.

Ambient Temperature (°F)	60	65	70	75	80	85	90	95	100
Choke Opening (Inches)	1/8	9/64	5/32	11/64	3/16	13/64	7/32	15/64	1/2
Ambient Temperature (C°)	16	18	21	24	27	29	32	35	37
Choke Opening (mm)	3.2	3.6	4.0	4.4	4.8	5.2	5.6	6.0	6.4

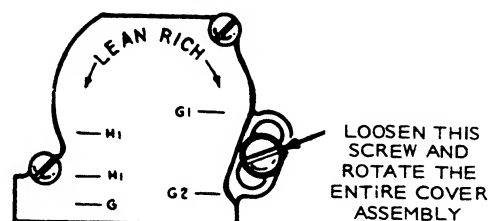
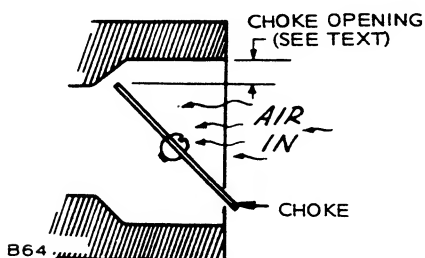


FIGURE 16. THERMO-MAGNETIC CHOKE ADJUSTMENTS



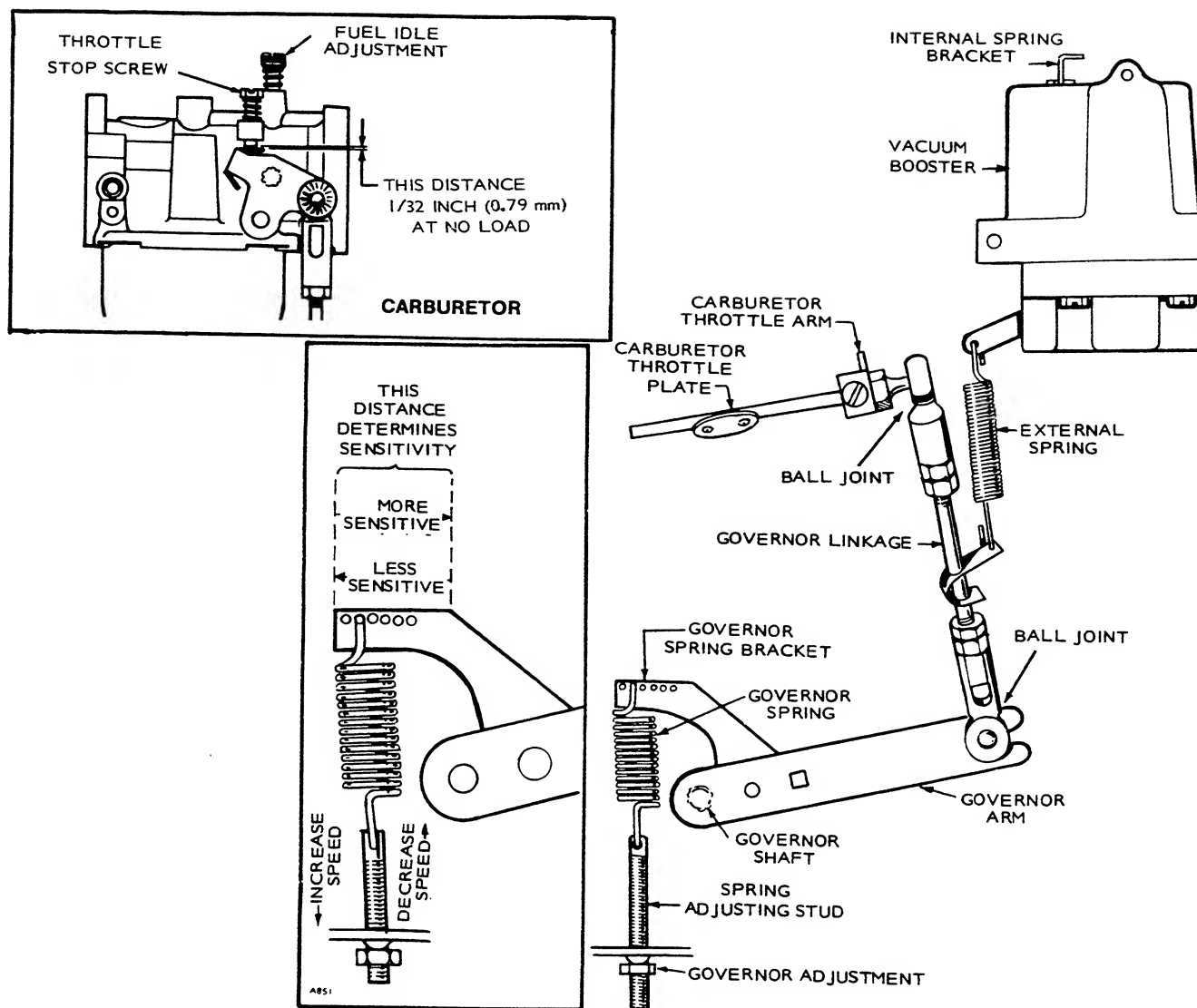


FIGURE 17. GOVERNOR DETAILS

**Speed Adjustment:** With the set at operating temperature and no load, and with the booster external spring disconnected, adjust the tension of the governor spring. Turn the speed-adjusting nut to obtain the correct voltage and speed reading.

**Sensitivity Adjustment:** Check the voltage and speed, first with no load connected, and again with a full load. Adjust the sensitivity to give the closest regulation (least speed and voltage difference between no load and full load) without causing a hunting condition.

To increase sensitivity (to get closer regulation), move the governor spring toward the governor shaft. An adjustment for too much sensitivity will cause alternate increasing and decreasing of engine speed (hunting).

To decrease sensitivity, move the governor spring toward the outer end of the governor arm. Too little

sensitivity will result in too much difference in speed between no load and full load conditions.

Any change in the sensitivity adjustment usually requires a compensating speed (spring tension) adjustment.

#### Vacuum-Booster Adjustment

1. After sensitivity adjustment, reconnect the booster external spring to the governor linkage (Figure 17).
2. With generating set running at no load, move adjustable slide to point where there is no tension on spring.
3. Apply full-rated load to generating set.
4. If the speed increases more than at no-load, lessen the speed booster's internal spring tension. To change tension, pull out the spring bracket and move the pin to a different hole (Figure 17). If speed decreases when the load is applied, increase the booster's internal spring tension.

# SERVICE AND MAINTENANCE

## PERIODIC MAINTENANCE SCHEDULE

Regularly scheduled maintenance is the key to lower operating costs and longer service life for the unit. The schedules can be used as a guide. However, actual operating conditions should be the determining factor in establishing a maintenance schedule. When operating in very dusty or dirty conditions, some of the service periods may have to be reduced.

Check the condition of the crankcase oil, fuel filters, etc., frequently until the proper service time periods can be established.

When any abnormalities occur in operation—unusual noises from engine or accessories, loss of power, overheating, etc.—contact your Onan dealer.

## CRANKCASE OIL

Check oil level daily and change oil every 100 hours of engine operation. If operating in extremely dusty, dirty or cold conditions, change oil every 50 hours. When adding oil between changes, use the same brand and weight as that in the crankcase.

Information on the correct grade and weight of oil is given in the *OPERATION* section of this manual. Oil capacity is 4 U.S. quarts (3.8 liters). See Figure 18.

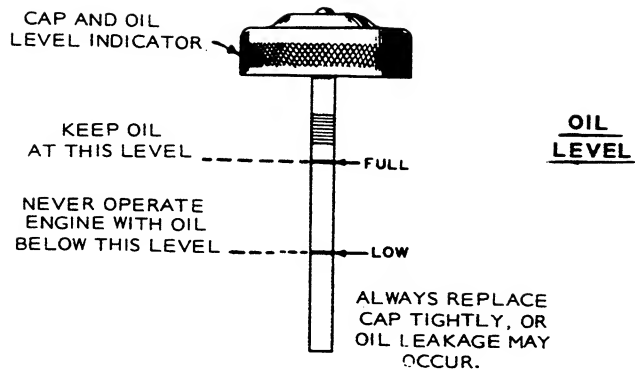
### WARNING

Never check oil level while engine is running. Hot oil discharged from the engine could cause personal injury.

SERVICE THESE ITEMS	AFTER EACH CYCLE OF OPERATIONAL HOURS					
	8	50	100	200	500	1000
Inspect Engine Generally	x1					
Check Fuel Supply	x					
Check Oil Level	x					
Clean Governor Linkage		x				
Service Air Cleaner			x			
Change Crankcase Oil			x			
Check Battery Electrolyte Level			x			
Clean Fuel Filter			x			
Change Spark Plugs				x		
Check Brushes				x		
Clean Crankcase Breather				x		
Inspect Breaker Points				x		
Clean Commutator Collector Rings				x2		
Check Valve Clearance					x2	
Remove Carbon and Lead Deposits					x2	
Clean Carburetor					x2	
Inspect Valves, Grind if Necessary						x2
Clean Generator						x
Remove and Clean Oil Base						x2

x1 - With set running, visually and audibly check exhaust system and fuel system for leaks, etc.

x2 - Contact your authorized Onan service center.



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FIGURE 18. OIL LEVEL INDICATOR

## CRANKCASE BREATHER

Clean the crankcase breather cap and valve assembly, and the breather tube baffle in a solvent every 200 operational hours. To remove breather cap and valve assembly, remove breather hose clamp and breather tube clamp. See Figure 19.

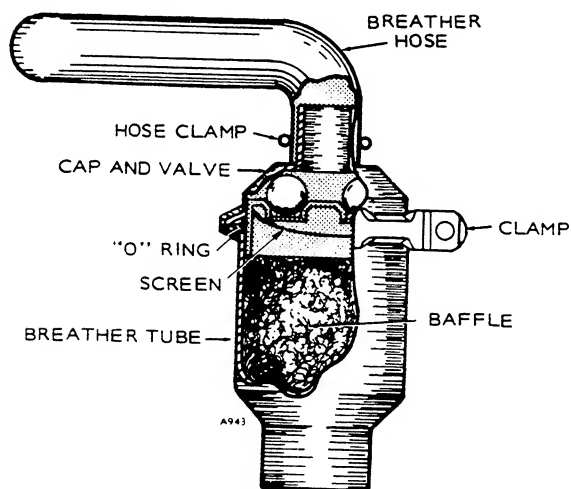


FIGURE 19. CRANKCASE BREATHER

## SPEED BOOSTER

Use a fine wire to clean the small hole in the short vacuum tube which fits into the hole in the top of the engine intake manifold. Do not enlarge this hole. If there is tension on the external spring when the unit is operating at no load or light load, it may be due to improper adjustment, restricted hole in the small vacuum tube, or a leak in the booster diaphragm or gasket. See Figure 20.

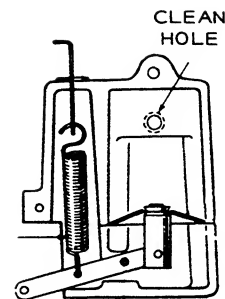


FIGURE 20. VACUUM SPEED BOOSTER

## FUEL FILTER (Where Applicable)

Every 100 hours, remove the fuel sediment bowl, empty, clean and dry (Figure 21). Remove the screen and clean any particles trapped. When replacing the sediment bowl, be sure the screen and gaskets are in place.

### WARNING

hazard.

Use extreme care when cleaning with a petroleum base cleanser due to potential fire

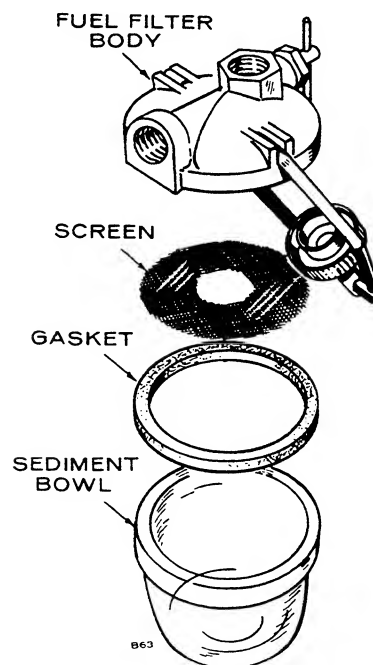


FIGURE 21. FUEL FILTER ASSEMBLY

## GENERATOR MAINTENANCE

The generator normally needs little care other than a periodic check of the brushes, commutator and collector rings. If a major repair job on the generator should become necessary, have the equipment checked by a competent electrician who is thoroughly familiar with the operation of electric generating equipment.

## SPARK PLUGS

Each time the spark plugs are removed, inspect, clean and regap (Figure 22). If the plug looks discolored or has fouled, replace it.

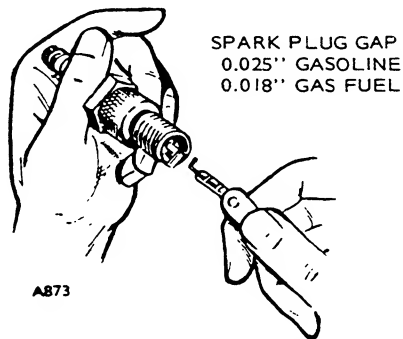


FIGURE 22. CHECKING SPARK PLUG GAP

## GOVERNOR LINKAGE

The linkage must be able to move freely through its entire travel. Every 50 hours of operation, clean the joints. Lubricate metal ball joints as shown in Figure 23. Do not lubricate plastic ball joints. Also inspect the linkage for binding, excessive slack and wear.

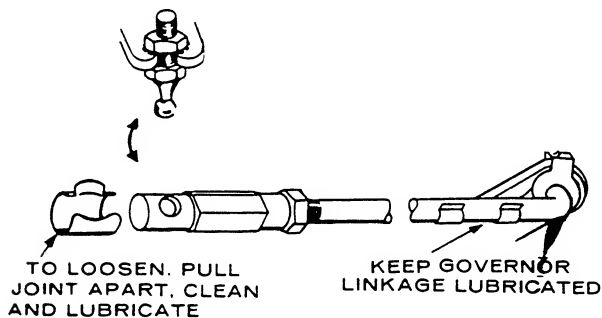


FIGURE 23. GOVERNOR LINKAGE

## AIR CLEANER

Proper maintenance of the air cleaner is extremely important. Negligence of regular routine maintenance will result in reduced engine life.

### CAUTION

Allowing the element to become plugged with dirt will restrict the intake of air into the engine.

Inspect the element for tears which would permit particles of dust or dirt to enter the engine. Clean the element in a suitable solvent, dry and oil as shown in Figure 24.

### CAUTION

Never run the engine with the air cleaner removed. Dirt will enter the engine and score the cylinders.

AFTER WASHING ELEMENT IN SOLVENT DIP IN ENGINE OIL AND SQUEEZE AS DRY AS POSSIBLE.

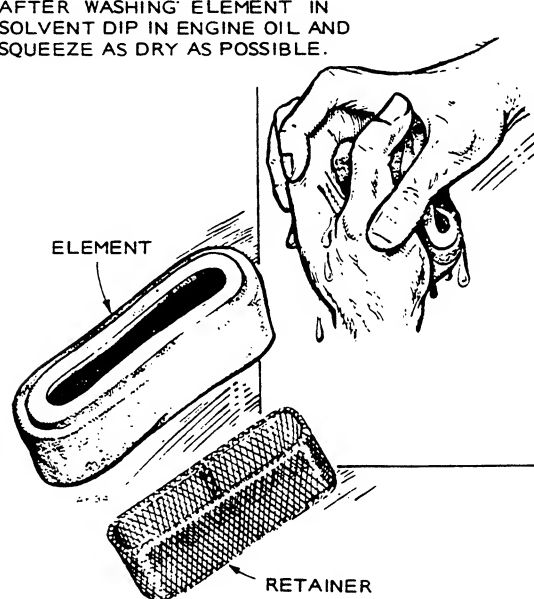


FIGURE 24. AIR CLEANER ELEMENT

# TROUBLESHOOTING GUIDE

TROUBLE																				GASOLINE ENGINE TROUBLESHOOTING GUIDE																				CAUSE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
Backfire at Carburetor	Bearing Wear	Black Exhaust	Blue Exhaust	Burned Valves	Connecting Rod Wear	Crankshaft Slowly	Cylinder Wear	Engine Stops	Failure to Start	Governor Hunting	High Oil Pressure	Low Oil Pressure	Loss of Coolant (Water Cooled)	Mechanical Knocks	Misfiring	Overheating (Air Cooled)	Piston Wear	Poor Compression	Ring Wear	Sticking Valves																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													</







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